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(54) Bus-bars and enclosures therefor

(57) A polyphase bus-bar assembly 3 comprises a plurality of bus-bars 9, 12 and 13 each formed of a strip having laterally extending tabs 11 and the strips are superposed with insulating layers 16, 17 sandwiched between them. The ends of the tabs of the different bus-bars may be in the same plane. The bus-bar assembly may be mounted in an enclosure 1, 35 containing a mounting rail 2 for circuit-breakers attached to the bus-bars.

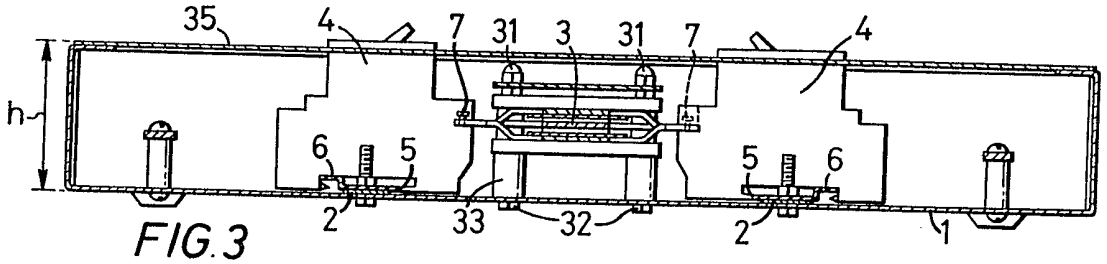

FIG.3

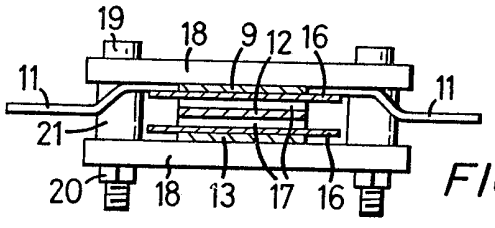

FIG.6

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

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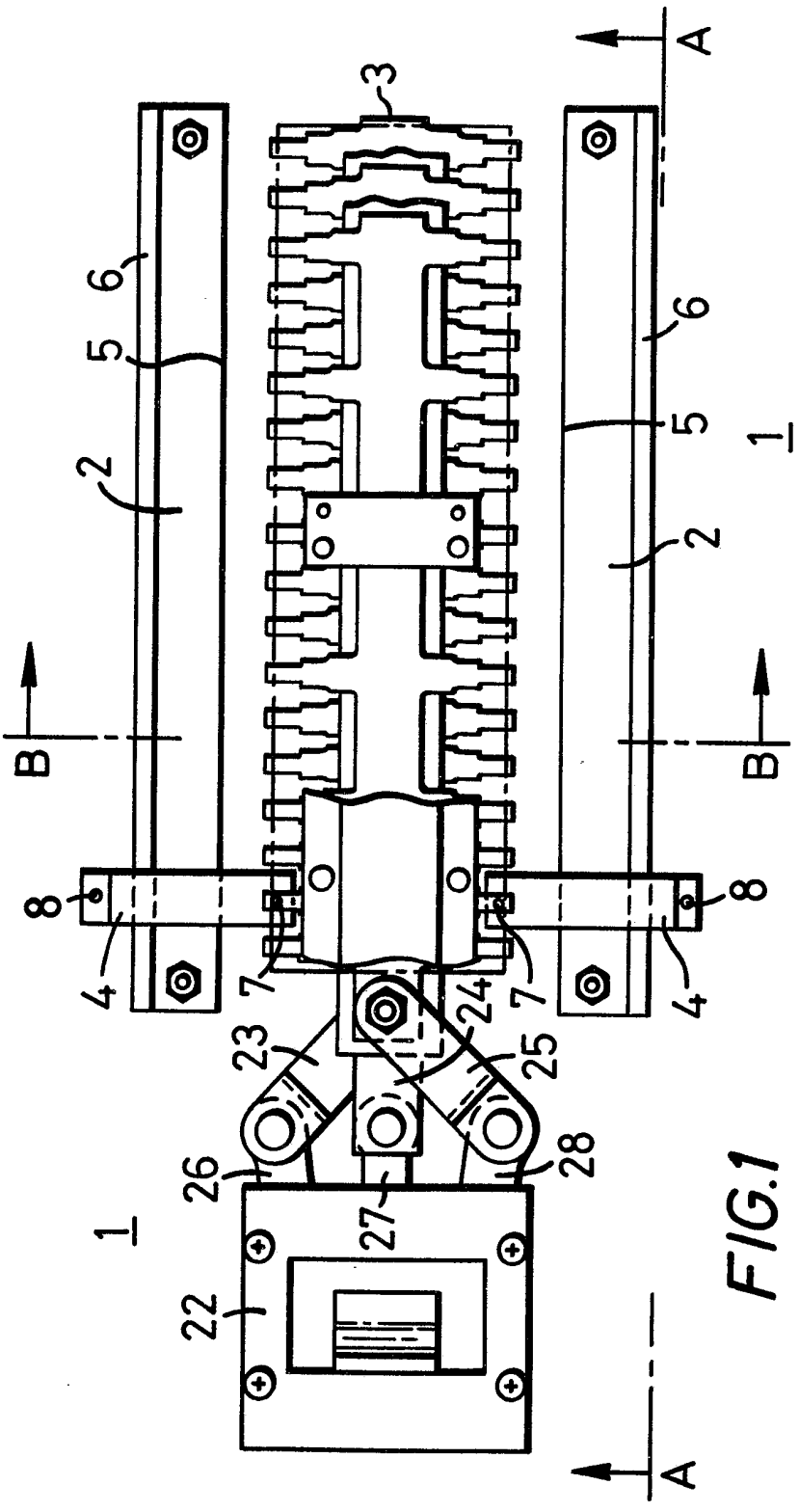

FIG.1

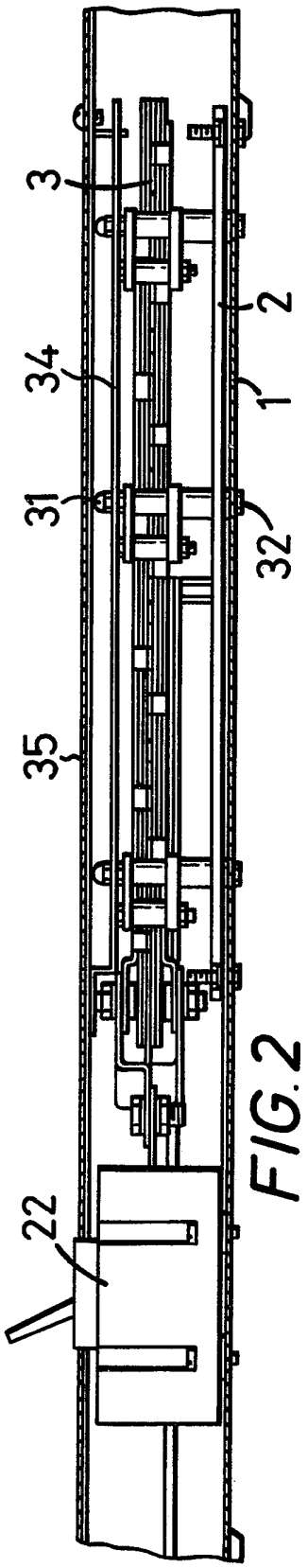

FIG.2

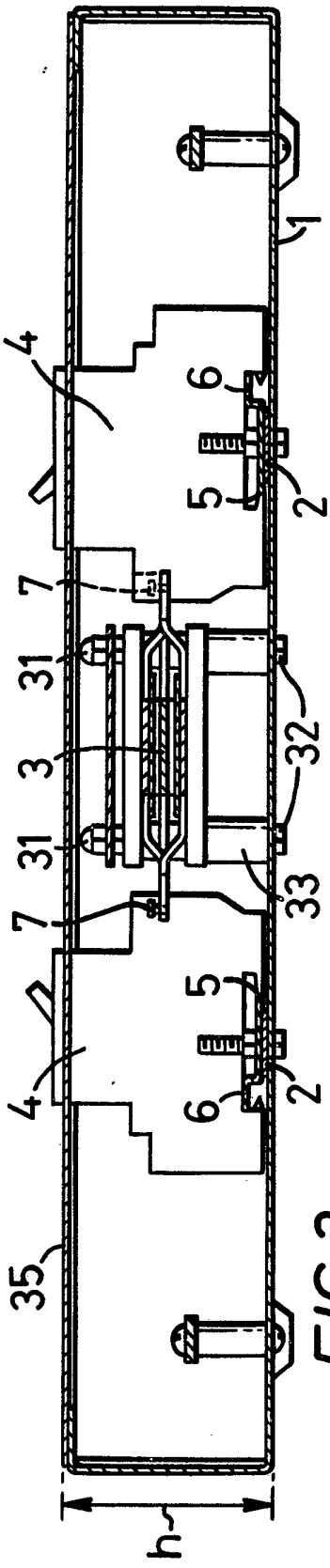

FIG.3

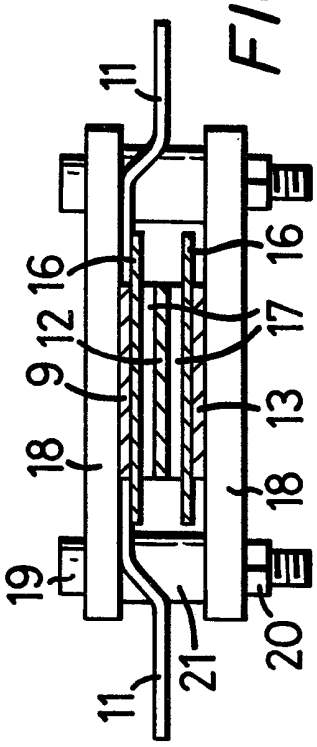

FIG.6

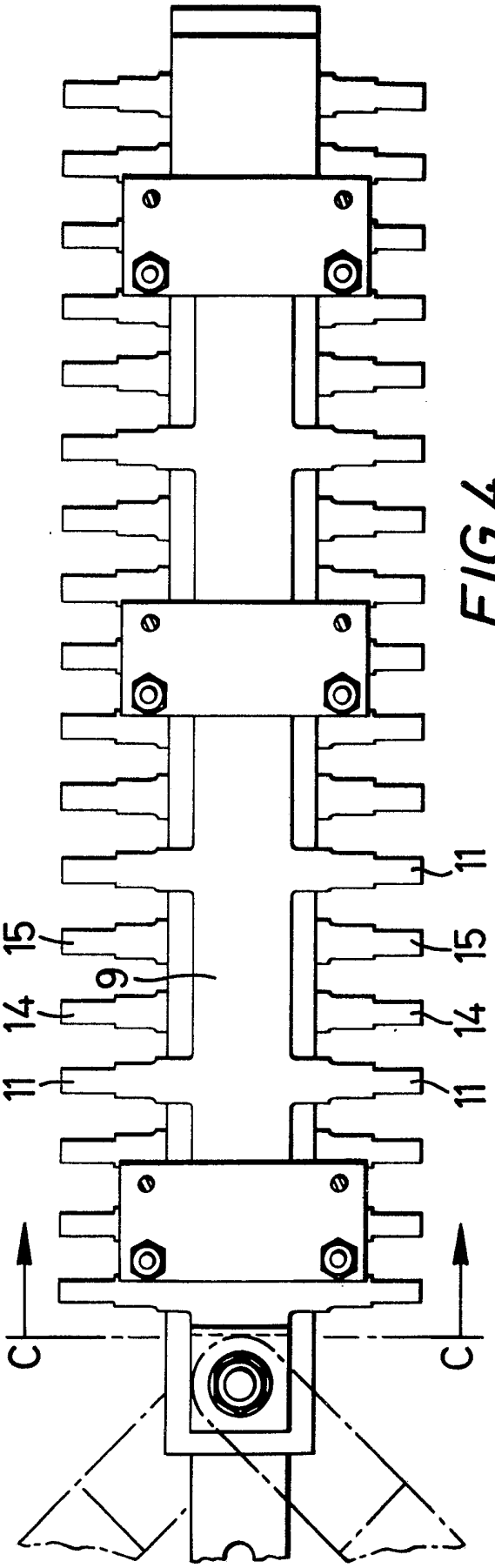

FIG.4

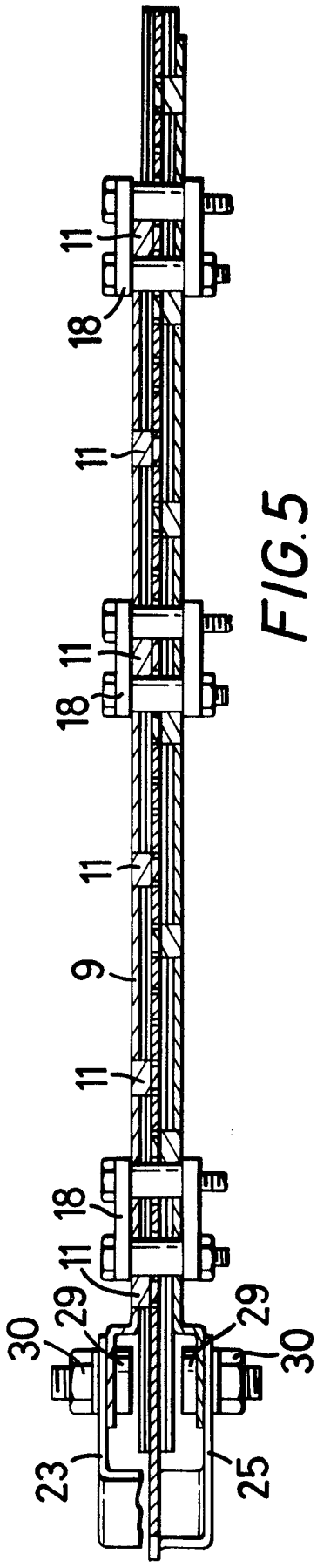

FIG.5

SPECIFICATION

Bus-bars and enclosures therefor

This invention relates to bus-bars and enclosures therefor in which electrical circuit components, particularly but not exclusively circuit breakers, may be mounted.

In domestic and industrial electric supply installations the current supply from a mains cable is commonly fed to an enclosure containing equipment for distributing the current to a large number of individual circuits. the cable may be connected to a longitudinal bus-bar in the enclosure and the bus-ban connected to components of the individual circuits along its length. The components are commonly circuit-breakers which are mounted on rails parallel to the bus-bar. When the enclosure is used in a polyphase system a separate bus-bar is required for each phase.

The present invention is intended to provide a bus-bar assembly and an enclosure to contain it which is compact and easy to manufacture and install while fulfilling accepted standards of safety and reliability.

According to one aspect of the invention there is provided a bus-bar assembly comprising a plurality of bus-bars each formed of a longitudinal strip having a plurality of tabs extending laterally from the strip for connection to circuit components, the strips being positioned one above another and separated from each other by layers of electrically insulating material sandwiched between the strips.

According to another aspect of the invention an enclosure contains such a bus-bar assembly and at least one rail for supporting components such as circuit-breakers side-by-side for connection to the bus-bars.

In a 3-phase system there will be 3 bus-bars to be connected to the different phases of the current supply. The bus-bars and insulating material separating them may be clamped together as a sandwich by suitable clamping means, such as plates of electrically insulating material, positioned at intervals along the strips. The tabs of the different bus-bars are generally staggered in the longitudinal direction with respect to each other at a longitudinal separation which is sufficient to avoid short-circuits between them and the layers of insulating material should be such that the lateral tabs of one bus-bar are separated from the adjacent bus-bar by a sufficient surface distance to avoid short-circuits caused by surface conduction (creepage). In order to achieve this, each bus-bar may be separted from the next by two layers of insulating material one of which is of greater width than the strip of the bus-bar adjacent thereto.

The tabs of the outer bus-bars of the sandwich may be bent so that the tabs of all the bus-bars are in the same plane, which may be the plane of the middle bus-bar.

It is preferred that both sides of the strips are provided with tabs so that two opposed lines of components may be connected to the same bus-bars.

The whole assembly of bus-bars and insulating layers, including the projecting tabs, may be between the planes defined by the outermost bus-bars of the sandwich. The overall thickness of the bus-bar assembly is then quite small and the enclosure containing the bus-bars may be of relatively small depth so that the whole unit is very compact. The enclosure may comprise a bottom on which the bus-bar assembly and rail are mounted and a lid opposite the bottom provided with apertures to allow access to the electrical components, notably to allow operation of switches of circuit-breakers mounted on the rail and the overall depth of the enclosure may be not substantially greater than the dimension of the electrical component perpendicular to the bottom, that is the height of the component.

A bus-bar assembly and a circuit-breaker enclosure according to one embodiment of the invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 is a plan view of an enclosure with the top cover removed,

Figure 2 is a cross-section along A—A of Figure 1,

Figure 3 is a cross-section along B—B of Figure 1,

Figure 4 is a plan view of the bus-bar assembly in the enclosure of Figure 1,

Figure 5 is a longitudinal cross-section of the assembly of Figure 4, and

Figure 6 is a cross-section along C—C of Figure 4.

The enclosure shown in the Figures comprises a box having a bottom 1 on which are mounted two rails 2 for holding miniature circuit-breakers in position. The circuit-breakers may be of standard type, for example the type sold by MK Electric Ltd. under catalogue number LN 5905. Rails 2 are parallel and mounted in opposed manner to hold two lines of circuit-breakers side-by-side with a common bus-bar assembly, indicated generally by 3 between the rails. In Figure 1 two of these circuit-breakers are shown.

Rails 2 are preferably of the type best seen in Figure 3, in which the rails 2 comprise an edge 5 close to the bottom 1 of the box and an upstanding flange having an outwardly directed lip 6. When a circuit-breaker is mounted on the rail 2 edge 5 and lip 6 engage opposite sides of the recess in the lower surface of the circuit-breaker, as shown in Figure 3, with the lip 6 under the catch in the recess and the lower surface of the circuit-breaker on either side of the recess is supported by the bottom 1 of the box which forms a pair of outer support members. The circuit-breaker is then securely supported by the rail and box bottom alone and does not impose any mechanical stress on the bus-bar to which it is connected. This method of mounting the circuit-breaker is described in UK Patent Application 2090065 A.

Each of the circuit-breakers has a terminal 7 comprising a clamping screw for connection to a bus-bar forming part of assembly 3 and a terminal 8 for connection to a wire, not shown in the drawings, forming part of the circuit which the circuit-breaker protects.

The arrangement shown in the drawings is intended for use in a 3-phase system and accordingly the bus-bar assembly 3 requires three bus-bars which are electrically separated from each other to supply the respective phases. The bus-bar assembly 3 itself is shown in Figure 4 in which one of the bus-bars 9 is visible. Bus-bar 9 comprises a longitudinal copper strip 10 having tabs 11 projecting outwardly from both sides in pairs to engage the terminals 7 of the circuit-breakers connected to bus-bar 9 as shown in Figure 1. In the drawings the tabs are shown as square-ended but the ends may be appropriately shaped, for example slotted, to allow electrical connection to the terminals 7 to be established. In the embodiment shown in the drawings bus-bar 9 has six tabs 11 on both sides, enabling up to twelve circuit-breakers to be connected to the bus-bar.

As best seen in Figure 6 the assembly comprises three similar bus-bars 9, 12 and 13 which are held together one above another and separted by insulating material. The middle bus-bar 12 has tabs 14 projecting outwardly from both sides and bus-bar lower has tabs 15 similarly projecting outwardly (Figs. 4 and 5). As may be seen from Figure 5, tabs 14 are coplanar with the middle bus-bar 12 but tabs 11 and 15 are bent out of the planes of their respective bus-bars in such a manner that their ends to engage the circuit-breakers are coplanar with the middle tabs 14. The bending of tabs 11 is shown in Figure 6. The tabs of all three bus-bars may thus be engaged by respective circuit-breakers mounted on rails 2 in identical manner.

The tabs on the different bus-bars are staggered with respect to each other in the manner shown in Figures 4 and 5 so that tabs 11, 14 and 15 are arranged in successive groups along the bus-bar assembly and they are spaced so that three circuit-breakers placed side-by-side on the rails 2 can be connected to the respective tabs of the three phases. The bus-bar assembly shown in the drawings has a total of 36 tabs, 18 on each side, providing a total of 12 groups of tabs each of 3 phases.

As best seen in Figure 6, the three bus-bars are separated from each other by a longitudinal relatively thin sheet of electrically insulating material 16 and a thicker electrically insulating sheet 17 of lesser width. Sheet 16 extends laterally beyond the bus-bar strips 10 thus defining a lateral distance between the outwardly projecting tabs of one bus-bar and the adjacent bus-bar which is occupied by electrically insulating material. The thicker sheet 17 together with sheet 16 defines the distance, normal to the bus-bar strips 10, by which the bus-bars are separated by insulating material. This arrangement avoids risks of electrical contact between a bus-bar and the tabs of an adjacent bus-bar caused by surface conduction.

The sandwich formed by the bus-bars and insulating sheets 16 and 17 is clamped together by plates 18 of electrically insulating material urged together by bolts 19 engaging nuts 20. The portions of bolts 19 between the plates 18 are surrounded by sleeves 21 of insulating material to avoid electrical contact between the bolts and the bus-bars and these sleeves may be integral with one of the plates 18. As shown in Figures 4 and 5 these clamping plates and bolts are arranged at intervals along the bus-bar assembly and the positions along the bus-bars of these clamping plates and bolts determines the positions of the tabs.

Electric current is fed to the bus-bars through main switch 22 and copper connectors 23, 24 and 25 clamped by nuts and bolts to respective lugs 26, 27 and 28 on the switch. Connector 24 consists of a simple extension of the middle bus-bar 12. Connectors 23 and 25 consist of copper strips clamped by nuts 30 and bolts 29 to the ends of bus-bars 9 and 13 which are bent as shown in Figure 5 to accommodate the heads of the bolts. Insulating sheets 16 and 17 prevent electrical contact between the bolt heads and the middle bus-bar 12. Connectors 23 and 25 are bent through two right-angles as shown in Figure 5 to bring their ends into the same plane as that of connector 24 for connection to lugs 26 and 28, which are coplanar with lug 27.

The angle in the plane of the bus-bar formed between the connectors and their respective bus-bars may be fixed by providing a square hole in the bus-bar end through which bolt 29 passes and a square flange around the corresponding hole in the connector which fits into the hole in the bus-bar. This angle may be 45° so that connectors 23 and 25 may be connected to either of lugs 26 and 28, allowing the phases of bus-bars 9 and 13 to be interchanged.

In another arrangement the bus-bars may be connected to their respective lugs on the switch by flexible connectors.

The manner in which the bus-bar assembly is mounted in the box may be seen in Figures 2 and 3. Plates 18 are clamped to the bottom of the box by means of bolts 31 and nuts 32, the bolts passing through sleeves 33 which define the distance between the bottom and the bus-bars. Bolts 31 also clamp in place a covering strip 34 of insulating material extending longitudinally above the bus-bar assembly. The box is closed by lid 35 which closes the entire contents of the box apart from the faces of switch 22 and the circuit-breakers 4 which are exposed through holes in the cover 35.

The enclosure arrangement described above is simple and easy to manufacture and is also very compact. The overall thickness of the bus-bar assembly 3 may be made quite small while remaining within accepted safety standards and the overall depth of the enclosure box may be no

greater than the height h (Fig. 3) of the miniature circuit-breakers themselves. The enclosure is easily mounted upright on a wall or the like and cables may then enter the enclosure from the top or the bottom of the enclosure. The bus-bar tabs, or the wires connected to the circuit breakers connected to them, will generally be identified to indicate the phase which they carry and as the phases of bus-bars 9 and 13 may be reversed by reversing connectors 23 and 25 a consistent convention for identification may be used for enclosures mounted in different manners.

Claims

1. A bus-bar assembly comprising a plurality of bus-bars each formed of a longitudinal strip having a plurality of tabs extending laterally from the strip for connection to circuit components, the strips being positioned one above another and separated from each other by layers of electrically insulating material sandwiched between the strips.

2. An assembly according to claim 1, in which the whole of the bus-bars and layers of electrically insulating material are situated between planes defined by the outermost bus-bars of the sandwich.

3. An assembly according to claim 1 or 2, in which the ends of the tabs remote from the strips of all the bus-bars are in substantially the same plane.

4. An assembly according to claim 3, in which three bus-bars are positioned one above another and the ends of the tabs are in the plane of the middle bus-bar.

5. An assembly according to any preceding claim, in which each bus-bar is separated from the next by two layers of electrically insluating material one of which is of greater width than the strip of the bus-bar adjacent thereto.

6. An assembly according to any preceding claim, in which the bus-bar strips and the layers of electrically insulating material are clamped together between plates of electrically insulating material.

7. An assembly according to any preceding claim, in which adjacent ends of the bus-bars are provided with respective connectors for connecting the bus-bars to different phases of a source of electric current, the connectors of the different bus-bars extending from the ends at different angles from the longitudinal axis of the bus-bars.

8. An assembly according to claim 7 comprising three superposed bus-bars in which the connector of the middle bus-bar extends along the longitudinal axis of the bus-bar, the connectors of the outer bus-bars extend outwardly on opposite sides of the longitudinal axis and the positions of the connectors of the outer bus-bars relative to the longitudinal axis may be reversed so that phases of the source of electric current connected to the outer bus-bars may be reversed.

9. An assembly according to claim 7 or 8, in which the ends of the connectors remote from the bus-bars are in a common plane.

10. A bus-bar assembly, substantially as hereinbefore described with reference to the accompanying drawings.

11. An enclosure containing a bus-bar assembly as claimed in any preceding claim and at least one rail to support electrical components connected electrically to the bus-bars.

12. An enclosure according to claim 11 containing a plurality of cirucit-breakers mounted side by side on the rail and connected to different tabs of the bus-bar assembly.

13. An enclosure according to claim 11 or 12, comprising a bottom on which the bus-bar assembly and rail are mounted and a lid opposite the base provided with apertures to allow access to the electrical components, the overall depth of the enclosure not substantially exceeding the dimension of the electrical component perpendicular to the bottom.

14. An enclosure for electrical components, substantially as hereinbefore described with reference to the accompanying drawings.

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